April 12th 1880. J. F. Campbell
for Publication 13th with
the Sheets

TIME SCALES,

HORIZONTAL AND VERTICAL,

CONTRIVED SINCE 1853 FOR

NUMERICAL PICTURE WRITING AND READING.

BY

J. F. CAMPBELL, F.G.S.,

AUTHOR OF 'FROST AND FIRE,' ETC.

LONDON:
EDWARD STANFORD, 55, CHARING CROSS, S.W.

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TIME SCALES,

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Picture Writing.

Every letter in every alphabet is a picture. By learning to associate form with sound and meaning we learned our letters. Having learned to see combinations rapidly, we learned to read, words first, and books afterwards. But nobody ever learned to read a whole newspaper at one glance. Roman and Arabic numerals mean numbers, which now have English names; but Chinese numerals still are shapes without sound or name or meaning in English schools. Egyptian picture writing has some meaning, because any goose can recognize the portrait of a goose; but hieroglyphics were incomprehensible till men learned to associate names, sounds, and meaning, with pictures of men, geese, serpents, and things which had names and double meanings in ancient Egypt. These pictures were used as letters now are. As nobody can read a whole sheet at a glance, it needs many mental efforts to master long sums and "tables" of figures. Each picture of a sound or of a number has to be joined to the idea expressed by it, and to the next figure, and the whole combination has to be carried on to the end of the series. If the spaces on this yearly time table were filled with numerals it would take at least 51,704 mental efforts to comprehend it. By special talent, or much practice, a skilled accountant grasps the meaning of long sums rapidly. He

Picture writing.

runs up columns of figures nimbly, with enviable mental agility. But people commonly think in pictures and easily grasp the meaning of simple shapes associated with ideas which fit them. A picture of a man suggests the idea of a man and the name "man" better than letters do.

Scale.

A "SCALE" is like a ladder: the same word in French and Italian means both, and a stair. "A rise" or "fall," expressed by a rise or fall upon a scale, like a picture of a man scaling a ladder, or walking up and down stairs, suggests the idea. Whole sums, and their results when drawn upon scales, are seen like single letters, and understood by one easy mental effort. Therefore a time scale, contrived for writing pictorially to scale, is easier to understand than A B C. It is a method of reading whole sheets at sight.

Season curves, A, B.

1. For example, throughout a year there is a gradual increase and decrease in the length of day. The times of sunrise and sunset for a year being drawn upon this time scale make two curves upon two parallel lines. It would cost 730 mental efforts to master numerals enough to take in that which is obvious in picture writing as is a word of two letters. *Mean sunrise is* 6 A.M., *but later and earlier according to season and latitude.*

C C Thermometer.

2. A very irregular continual rise and fall of mercury or spirit is measured by ladder-like scales of thermometers. Daily observations recorded pictorially during 1855 taught the writer that which has been proved at Greenwich by continuous combined meteorological observations since 1814. Irregular mercurial ups and downs are like passing waves at a tidal pier. Daily averages on a series of years, when drawn with season curves, are seen to agree with them. Daily mean temperatures for many years make it probable that the average local temperature will recur about the same season

yearly, as winter, spring, summer, and autumn. It took a vast amount of skilled labour and a long time to prove accurately at observatories that which everybody knows roughly. It puzzles unskilled readers to master the details; but three curves drawn to scale are as easy to read and to understand as A B C. *How temperature and season roughly correspond is understood at sight.*

3. Local atmospheric pressures, measured by inches and fractions of inches upon the scales of barometers, continuously, or hourly, or daily, for a year, or for a series of years, when averaged to scale take the shape of waves. Pressure curves probably, do in fact, picture air waves passing over a place. A barometer at the bottom of the sea would rise and fall with tides and waves; great and small, daily, hourly, and continually. But, upon long averages, sea waves and tides are calmed to a "*mean*." Notwithstanding daily tides and stormy waves and ripples, there is a mean calm "*sea level*" from which to measure mountains above it and depths beneath it. There is a "*mean*" air level also which is measured by weighing air against mercury or some other fluid, or a spring. That "*mean*" is generally taken to be equal to a column of mercury 30 inches high at the mean level of the sea. Barometrical air soundings, like sea soundings measured against a scale upon a post, probably show varying depths. The mean for days and years comes to be a curve drawn upon a straight line or on a circle. Four curves read like a word of four letters, say TIME. *According to the time and season so are average barometric pressure and temperature.* Barometer, D D.

4. An instrument for registering and measuring the intensity of sunshine makes a fifth curve. Read with the other four the meaning is as clear as a word of five letters, say SCALE. *The sun's force works the air engine.* E E Dial.

So it is with any number of weather curves written together upon the same time scales for comparison. Who first invented numerical picture writing the writer never was taught; he learned the art in this fashion practically.

Practical Picture Writing.

Brown's tables.

In 1854, during an epidemic of cholera in London, the Assistant-Secretary of the General Board of Health acted as Secretary to a Medical Council, and managed some meteorological observations. Having seen the prices of corn, funds, and such like numbers drawn upon scale paper, and hung up in merchants' offices, and having learned the method of registering meteorology mechanically at Greenwich upon rollers, he sought for a table in which to picture daily office observations. The only table of the kind that could then be found by H.M. Stationery Office was "Brown's Patent Registering Table." It is a journal for a year, not a time scale.

Report on cholera.

Copies were got, altered, and used in the office. In 1855 the Report on Cholera was published officially. In that book are tables which picture numbers. Of these one was prepared by the Scientific Committee of the Medical Council, with the help of Mr. Glaisher, of the Greenwich Observatory, and Doctor Farr, of the Registrar-General's Office, who is a master of picture writing. That chart shows daily sickness and daily weather, on scales, by curves and colours. But the chart is a journal, like "Brown's Patent," not a time scale, with a common plan. On it is a curve of average daily temperature, founded upon numbers furnished by Mr. Glaisher. Something was needed with which to compare

Greenwich means.

the weather of the cholera year, 1854. In 1857 Mr. Glaisher sent Greenwich averages to the Meteorological Society, who

printed the numbers. In eight pages are more than seventeen thousand numbers, each of which is a mean of 43 daily means, or of 516 monthly means, or of 43 yearly means. The sum of the whole series is the mean temperature of the place; which is between 49° and 50°: 49°·72, as now stated. The mean temperature at the Observatory is near about 50°, and that has been taken as the mean. The mean daily temperature there ranges with the season, about 15° above and as much below 50°; from 35° to 65° in round numbers, according to the latest estimate published.

A vast number of local means of this elaborate sort, drawn upon Mercator's map, from "Dove's Isotherms," &c., are in Keith Johnston's 'Physical Atlas,' Edinburgh edition, 1861. That numerical picture writing means *climates*. It is a result like a sum. Glaisher's numbers, furnished to the writer in manuscript in 1855, were printed afterwards by the Meteorological Society as from "all the thermometrical observations taken at the Royal Observatory from the year 1814 to the end of 1856." Numbers used at the Royal Observatory for daily comparison were accepted as of authority, and used officially at the Board of Health. In 1854 the writer wanted to show picturally, and compare the relation between daylight and daily local temperature. So he contrived two time tables for the General Board of Health. He first planned the method by pricking Glaisher's numbers and numbers from an almanac upon Brown's scale. The curves were drawn by Mr. Haile, an able professional draughtsman employed in the office, and the result was lithographed by Day and Son for H.M. Stationery Office and for the public service. The table was used officially for about eighteen years. Weather charts, begun in 1855 at the Board of Health, were handed to the Weather Depart-

Dove's isotherms.

Season temperature.

Time scale.

ment in 1873, together with records of sunshine begun in 1854.

F F Sunshine curve.

These were the first of their kind, engraved with a glass globe by sunlight, upon forty bowls of hard wood, one for each half-year. A paper in 'Good Words' for 1879 describes the instrument.

Dial.

The contriver of this method of solar engraving, and of the time table founded upon it, explained both to the head of the Weather Office, to whom both then were novelties. He approved them, and since 1873 they have come to be used.

1861.

The Report of the Lighthouse Commission, 1861, contains many other picture writings to scale contrived by the Secretary and approved by the Commission. A friend who

'Times.'

was on the 'Times' staff saw a meteorological tabular record at the writer's house for the first time. Weekly weather pictures of Kew observations followed.

Numerical picture writing now is familiar to the public, who have learned to read that sort of writing practically from the daily press.

Daily air tide.

In April 1878 Mr. Ellis, who succeeded Mr. Glaisher at Greenwich, was kind enough to send the writer a paper, reprinted from the 'Quarterly Journal of the Meteorological Society' for October 1877, on the "Diurnal Variation of the Barometer." It contains diagrams which show numbers pictorially. Two "*waves*" of high pressure, with troughs of low pressure between them, occur daily at Greenwich, Oxford, Washington, the Cape of Good Hope, and Ascension, at times which vary with the times of sunrise and sunset. "When there is little change in the times of sunrise and sunset there appears to be also little change in the times of the barometric maxima and minima." It further appears

that in cloudy regions the variation is less. "It is much more strongly marked at Washington, the Cape, and at Ascension, than at Greenwich or Oxford" (p. 470). These two are in cloudy English climates.

"This points to the action of heat as the principal cause" of the solar diurnal variation, according to Mr. Ellis and other writers. The register of sunshine measures active radiation.

Greenwich means.

In 1878 the reduction of twenty years of photographic records of the barometer, and dry and wet bulb thermometers, &c., at Greenwich, were published by order of the Admiralty. In March 1879 a copy was sent to the writer. In that able Report are plates which picture means, and are very easy to understand. Numbers have been taken from this work.

Australian means.

In May 1879 a friend was kind enough to lend the writer the Report of the State Astronomer on the Climate of New South Wales, 1877. In that Report, amongst other diagrams, is one showing the diurnal change of the barometer at Sydney, from means of five years' registration by the "barograph." Waves and troughs recur there as elsewhere about the same times of day, varying with season and latitude. From "Brown's Patent" onwards all these are for numerical picture writing to scale; all are journals, none are time scales, upon the principle now drawn. Who first invented the method of expressing numbers by curves the writer never was taught. He learned it himself by degrees, step by step, as others scale the ladder to learning, by making a system fit his purpose. These time scales, cylindrical and circular, horizontal and vertical, result from practice since 1853. They are attempts to make facts more comprehensible to the contriver who learns by eye and thinks in pictures, as mankind in general do.

Horizontal Time Scale.

The writer's intention since 1853 has been to express divisions of time by measured spaces upon a continuous band of paper wound like thread upon a reel, and to picture numbers together with time, so as to be easily compared. The yearly
Dial. time table was contrived upon the principle of a dial, in which the focal cone of a transparent sphere, turning round with the world, engraved a spiral upon a band of ribbon and upon wood during half a year, and crossed it during the next half. That solar "*thread of time*" is wound like cotton on a bobbin from end to end, from tropic to tropic, and back again. The thread is cut daily by the horizon at sunset, and at uncertain times by clouds. But after more than twenty years, despite of clouds, the point of the hot graving tool has carved a hollow an inch deep, which is the mean result of the sun's burning power at the place. The daily trace being crossed half-yearly and recrossed yearly, and partially obliterated daily, and being drawn upon a spherical surface, had to be expressed otherwise for a book.

During March 1857 a daily trace was copied upon a time scale daily, and in April 1857 was sent with a description of the dial, which the Meteorological Society printed. A duplicate picture is preserved. It was shown to the head of the Weather Office in 1873. A record made in June 1874 was copied on a Board of Health time table, and used while travelling round the world in 1874–5. Records and a dial were sent to Greenwich. Since May 1876 the work of the dial, expressed in numerals, has been published by the Observatory. But hitherto the system of recording sunshine and time together upon one endless band has not come to public notice.

So far as the writer can discover in August 1879 no time table has yet been published founded upon the principle on which he has worked since 1854 at home and abroad. *In atmospheric mechanics the sun supplies power.* That is one principle which these tables illustrate.

'Frost and Fire.'

One mean result of the greater part of a book written by the writer of this paper ('Frost and Fire,' 1865) is that *solar force is recorded in superficial geology*, as well as in daily work done by the atmosphere, as "denudation." In the present as in the past solar force acts mechanically, in the atmosphere and on the earth's surface, with less or more power according to seasons and times.

Time scales.

"Campbell's time scales" are like a roller and the end of it. Both are intended for expressing numbers and quantities by spaces measured upon plane surfaces, vertical and horizontal. Time is measured by parts of circles upon dials and watches. Temperature and pressure are measured by spaces, which are parts of parallel straight lines, upon the scales of barometers and thermometers. Pictures are copied "to scale" in proportion by using squares of even size. Paper, crossed by straight lines at right angles and equal distances, is used for needlework by women, and for plans and sections by engineers. Surveyors make plans and geographers make maps by drawing to scale. Drawings upon a plane surface divided evenly are upon a scale of two dimensions. A vertical plane gives a third dimension. Time, temperature, pressure, pictures, stitches, acres, fields, countries—anything that can be measured or counted—may be expressed pictorially by dots and lines on counted spaces in a sheet laid flat in the plane of the horizon, or on a sheet suspended vertically in the plane of the meridian, or made for the equatorial plane.

Scales. Values.

Any value may be put upon a scale. Circles divided by 60 read minutes and seconds upon a watch; divided by 12, a circle reads hours in half a day, and miles on a pedometer dial; divided by 24 it reads hours in a whole day: 24 times 15°:—24 equal parts of 360°. The same divisions may read to any fraction. A carpenter's foot rule is divided by 12 for inches, and subdivided for fractions of an inch. Ordnance Survey maps express miles by inches, and by 6 inches, and by 25. Maps and charts read degrees, and parts of them, to scale. Like all these "pictures to scale," these tables are intended for pictures of any numbers which are otherwise expressed by other forms, such as 1, 2, 3, 4:—I., II., III., IV. The yearly time scale is divided into twelfths of an inch. In one direction are 366 spaces, each 1 foot long; one space for each day in leap year. In the other direction are 144 spaces, one space for every period of ten minutes in each day of twenty-four hours. These numbers squared give 51,704 square twelfths of an inch, which are intended to have these values, to begin with.

Values of the Scale, Left to Right.

Spaces.	Inches.	Time.	Degrees of a Circle.
1	One-twelfth	Ten minutes	2° 30′.
2	One-sixth	Twenty minutes	5°.
3	One quarter	Half an hour	7° 30′.
6	One half	One hour	15°.
12	One inch	Two hours	30°.
72	Six inches	Half a day	180°.
144	One foot	One day	360° { of longitude in any latitude.

Crosswise	365 twelfths	One year.
	1	One day for leap year.
	366	
Thermometer ..	One space	One degree.
Barometer	One space	0·001 inch.
Dial	The same as Time (1 space, 10 minutes).*	

* One second of clear sunshine is recorded as a round dot ●; one apparent sun's breadth burned by the sun's image on wood or cardboard.

The meridian, at noon, coincides with any mean number. It may be used to express numbers above and below any average in a vertical plane, as curves like waves; or to show increase and decrease right and left upon a horizontal plane. One of Glaisher's tables has been laid down on *the ground plan* to show how temperature corresponds to season; to the duration of sunshine measured by sunrise and sunset; left and right, east and west of the meridian when the paper is horizontal. Other such tables have been arranged on the same plan.

Mercator's Cylindrical Projection.

The principle of the scale may be understood from a well-known map. On "Mercator's projection" the geography of a revolving sphere is drawn as if the globe were a rolling cylinder. Newspapers are printed from rollers, whose surfaces unrolled are planes. Like them, the map is a cylinder unrolled. Meteorological records are taken photographically upon papers rolled about cylinders moved by clockwork. The registering dial is turned round by the world. When this flat sheet, contrived for a year, is rolled into a hollow cylinder, so that the first and second day spaces join, then the day columns become a continuous measured spiral band 366 feet long and $\frac{1}{12}$ inch wide. The scale is like a measuring tape wound upon a roller 1 foot in circumference and $2\frac{1}{2}$ feet long. One coil of the measured band represents one turn of the world upon its axis. Three hundred and sixty-six turns represent leap year. One turn represents one circle of longitude in any latitude, as it is drawn upon Mercator's cylindrical projection of the world's surface. The cross scale upon the endless band divides it, as meridians divide Mercator's map, for time and for degrees of the circle which measure time. The line which halves the day columns corresponds to the meridian of the place.

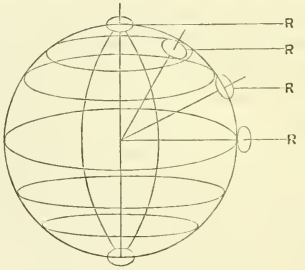
Hour lines, drawn parallel to each other half an inch apart, correspond to twenty-four meridians, usually drawn upon maps and globes 15° apart in any latitude.

Two season curves show the times of sunrise and sunset; shade represents night, light day, in summer and in winter, throughout a year, at Greenwich, which is the English point of departure used in navigation.

In short, the cylindrical yearly time scale represents the sun's apparent motion round the world, as an endless band, wound upon an endless roller. It is founded upon the instrument on which the sun engraves an endless spiral divided by spaces which equal days and nights during years anywhere.

Mercator's map represents the world as a cylinder. The yearly scale represents the old classical idea of "*a thread of time*" rolled upon a revolving world.

Cylinder.



Globe.

Horizontal Bearings.

The hollow cylinder unrolled is a rectangular sheet. Laid flat it is in the plane of the horizon, and, like Mercator's map, it has compass bearings.

The world and the plane of the horizon of any place turn together eastward, passing stars at the regular pace of the world's rotation. All that almanacs foretell in numbers may be pictured upon time scales. The sun's apparent position at Greenwich being known, the observer's place is shown by measuring space east or west from the meridian, or north and south upon it. The moon's place with reference to the meridian which halves the horizontal plane, its rising, southing, and setting, being calculated, may be shown by marking times upon the time scale for a current year.

"High water at London Bridge," the rising and setting of stars—in short, any daily event that can be calculated beforehand or recorded afterwards, from Astronomy and Meteorology down to gastronomy, dinner-time, and bed-time—may be noted upon a time scale.

By the bearings, the direction of the wind at any time may be recorded by an arrow drawn in a space. It was done at home in 1857, and at sea in 1874, and it may be done anywhere.

In short, a time scale may be turned into a pictorial almanac for any year, on which to record and compare observations while travelling, or it may be used for means.

(1) For instance, the sun's altitude and apparent time for rising, for passing the meridian, and for setting vary with latitude and longitude. By observation sailors navigate. This time table may be used as if it were a skeleton map, on which to note a traveller's daily longitude. It was done in 1874–5 round the world.

(2) Between the tropics sunrise and sunset nearly coincide with the hour lines of 6 A.M. and P.M. In these low latitudes the sun takes about two minutes to hide beneath the sea horizon, and is overhead at noon twice in the year on the

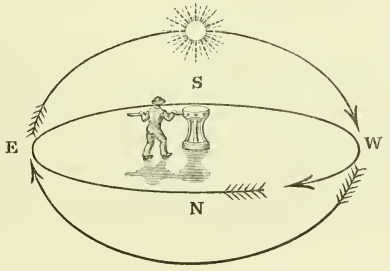
line. Within the Arctic circle the sun appears to slide into the sea. In high latitudes, where the plane of the horizon makes a small angle with the plane of the equator, curves which represent the rising and setting of the sun upon the horizon of a place approach lines which represent circles of longitude. At the North Cape of Europe there is no sunset during six weeks, and no sunrise; therefore the corresponding days before and after the longest day must be left white on a time scale, if carried so far north.

For the poles, where the horizontal plane is parallel to the plane of the equator, sunrise and sunset curves have to be drawn upon day lines parallel to the tropics, and at right angles to the meridian plane. The sun, which sets in two minutes at the equator, takes as long a time to set at the pole as it takes to move its own breadth in declination at the equinox. Intermediate differences due to latitude may be noted while travelling, or drawn while stationary.

Reading Sunwise.

The scale is made for reading from left to right and from top to bottom, like an English newspaper. It is founded upon the natural astronomy of unlearned men. In the northern half of the world a man sees the sun pass in front of him, from left to right, from east to south, and to west. If he faces the sun all day he revolves sunwise. If he walks after the shadow of a tree, he walks with his right hand towards the tree; consequently, "Solar Poojah," the sun-worship of Hindoos, includes various astronomical motions and postures, such as hopping round upon one leg sunwise. Nearly all northern perambulations—superstitious and religious, pagan and Christian, savage and civilized—are made on this same principle of natural astronomy. Hindoos at Benares, and all

over India; Sikhs in the Golden Temple; Buddhist prayer-wheels in the Himalayas; maypole dances in England; Greek dances; processions in the Hebrides about brides, graves, boats, and churches; High Church and Catholic processions—in short, nearly all northern rounds made for joy, or for blessing, or for luck, follow the apparent motion of sun and stars, and partake of "Solar Poojah." The hands of watches and astronomical telescopes, and the shadows of dials, and men, and trees, all turn "sunwise." Therefore, the band of paper which is the foundation of this time scale is made to coil like a rope coiled by a northern sailor. It reads *sunwise*, from left to right:—East, South; West, North.



Mahomedan sacred perambulations in Egypt and at Mecca, and Aryan incantations for evil, are made "widershins," with the left hand towards a centre, in accordance with the world's *real* motion, from west by south to east. The table may be read backwards, to suit the southern half of the world, and the views of those who know that apparent sidereal motion is the unreal astronomy of observers who do not know, or knowing deny, that the world turns round.

Consequently, the bearings differ from those of a map.

The top of the time scale is South; East is to the left; West to the right. The sun at noon is in front of an observer in the northern half of the world who faces south. If he walks round a post, he walks *sunwise*, or, in Gaelic, "*Deisuil*."

From these few pages, the contriver of this yearly time scale hopes that the principle may be understood and worked. Another diagram for daily averages is ready in manuscript.

J. F. CAMPBELL.

NIDDRY LODGE, KENSINGTON, LONDON, W.,
August 15, 1879.

NOTE.—February, 1880. For Sunshine, its Registration, and its Effect on "Weather," see *Good Words*, October, 1879, page 706; *Nature*, August 21, 1879, page 403; the Reports of the Astronomer Royal, and of the Registrar-General, published in the daily papers, &c. After August, 1879, the writer further tested his theory of weather by travelling in search of clear skies, which were found where they were expected. Daily air-tides, and the condensation and dispersion, and the rise and fall of mists and clouds in calm days, were again observed from hill stations in the Alps and elsewhere, at sunrise and sunset. The practical weather experience of a traveller is embodied in the diagram mentioned above, and in a descriptive paper which is ready.

LONDON: PRINTED BY EDWARD STANFORD, 55, CHARING CROSS, S.W.